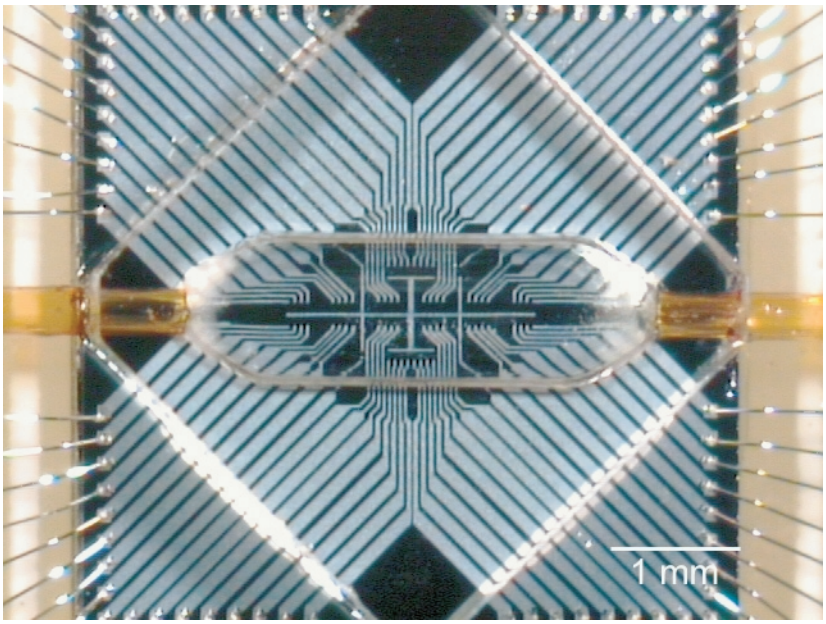
A BIOSENSOR ON A CHIP: THE BEAD ARRAY COUNTER (BARC)



The Naval Research Laboratory, with support from the Defense Advanced Research Projects Agency (DARPA), is developing a revolutionary tabletop biosensor for the detection of multiple viral and bacterial pathogens. The pathogens will be identified by their known deoxyribonucleic acid (DNA) sequences, with an initial focus on detecting biological warfare agents. Small spots of single-stranded DNA designed to bind to DNA from the target pathogens are first patterned on top of a chip containing an array of miniature sensors. The sensors are micron-scale strips of giant magnetoresistive (GMR) material that can be configured to electronically sense very small magnetic fields. When a solution containing DNA from unidentified pathogens flows over the array of DNA spots on the chip, DNA strands that are from a known target hybridize with their complementary strands and these molecules are captured onto the surface. Micron-sized magnetic beads, specially designed to bind only to target DNA molecules, are then injected into the solution. Finally, a magnetic field is applied that removes any beads that are not specifically bound to the surface by the target. Only the beads bound by the pathogen DNA remain. The GMR sensors detect these beads, and the intensity and location of the signals therefore indicate the concentration and identity of any pathogens present. The current BARC chip contains a 64-element sensor array; however, with recent advances in magnetoresistive technology developed for computer memory, chips with millions of GMR sensors will soon be commercially available. This advance will speed the development of a BARC chip capable of screening for thousands of analytes simultaneously. Because each GMR sensor is capable of detecting a single magnetic bead, in theory, the BARC biosensor should be able to detect the presence of a single pathogen DNA molecule.

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